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SOME POLITICAL EFFECTS OF COMPUTATION IN LATIN AMERICA

by

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This research is based on field work done in Latin America during the summer of 1972, and the months of January and February of 1973. It is part of a larger project on the development of the computer industry in Latin America being carried out by the author with support from the M.I.T. Seed Fund.

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INTRODUCTION:

Computer technology has, in little over two short decades, left its indelible imprint upon the history of mankind. The achievements made possible by computation would undoubtedly highlight any list of postwar scientific events of major importance. Yet it hasn't been in the field of science only that the computer has made an impact. Its terrific capacity for information processing and data manipulation has truly revolutionized major areas of industry, commerce, banking, public utilities, services, etc. The effects of this revolution have largely contributed to the economic development process that has also characterized the more advanced nations in these last few decades. At the same time, the diversity of applications, the diminishing costs, and the ease of handling have allowed the computer to enter most of the less developed countries by now. Latin America, a developing region par excellance, has been introduced to computers for more than fifteen years; although the existence of a phenomenon called "computation" should not be dated before 1964-65. Those were turning point years in some of the larger countries in Latin America around which a critical mass of computer activity, or computation, developed beyond truly trivial levels.

The large scale use of computers for information processing has had a number of additional side effects of a social, political and economic nature. In the United States, for example, the issue of privacy and the establishment of a national data bank has caused a large amount of discussion and argumentation, even reaching the level of congressional hearings. The prob-

lem of human alienation due to computerization has also been under study for sometime, after the emergence of such phenomena as groups solely dedicated to sabotaging computers and other data processing equipment. Governments, at the federal, state and municipal levels have become prime users of computers and in the process completely changed behavioral habits in areas such as income tax reporting, parking ticket payments, etc.

In Latin America the situations are as varied as countries exist in the region. Yet governmental attitudes, awareness, and attempts at dealing with the problems do follow certain patterns, and some models have apparently been established. These models are generally determined by the overall political leanings of the governing regimes, or better still, by the priorities they have set for their governments. In any case, due to the importance that computer technology might have in aiding economic development, or hindering it if large amounts are erroneously allocated, the attitude of the different governments will be transcendental.

Likewise, in the future developments to monitor or control computation in the different countries, there will be many an attempt to also monitor and control the information that is to be processed by the computers. The effects that this might have on the political development of said countries could also be of vital importance.

The stage is set, therefore, to do a brief analysis of computation in Latin America and look at the political effects which it has produced in the different countries that comprise the region, as well as attempt to determine what the future will do to the different models.

OVERVIEW OF COMPUTATION IN LATIN AMERICA:

In order to study the political effects of computation in any region, one must first have at least the basic notions of the computer activity that takes place in that region. Therefore, an overview of computation in Latin America will be presented focusing on:

1.- Installations
2.- Applications
3.- Education
4.- Personnel
5.- Wages
6.- Chronology

Although this overview will provide for a greatly simplified vision of the region's computer activity it should be complemented, for a clearer understanding of the situation, with a categorization of the Latin American nations according to their actual level of computer usage and short term potential for the same. A full expansion of the basic work done in this area[1] is beyond the scope of this paper, but the resulting categorization gives a good insight as to the region's grouping. The sets of countries appearing in TABLE 1 correspond to the divisions in the continuum of the CIDP (Computer Industry Development Potential) Index generated for each country utilizing relative weights for eleven economic, educational and technological variables. The fact that the classification was done more than one year ago, and therefore with data reflecting a situation at least eighteen months prior to that, yields as a result that some updating is probably in order. Based on personal experience and research

TABLE 1

Table of CIDP Indicator Groups

	COUNTRY	CIDP
	Argentina	76.42
(GROUP A)	Brazil	69.69
	Mexico	69.23
(GROUP B)	Puerto Rico	61.53
	Venezuela	52.01
	Chile	40.55
	Colombia	39.25
	Uruguay	38.52
(GROUP C)	Panama	38.32
	Costa Rica	34.53
	Peru	32.20
	Cuba	31.63
	Nicaragua	27.16
	Dominican Rep.	26.27
	Ecuador	25.99
(GROUP D)	Paraguay	24.39
	El Salvador	24.33
	Guatemala	24.21
	Bolivia	23.82
	Honduras	23.08
(GROUP E)	Haiti	9.13

by the author it would seem that neither Argentina nor Nicaragua are at the head of their respective groups, Argentina having dropped probably behind Mexico in Group A, and Nicaragua behind Ecuador in Group D. Aside from these two observations, the relative positions still appear to hold true.

These groups also can be relatively easily mapped into an expanded United Nations Computer Activity Level Chart.[2] This allows for easy comparison with the quite accurate characterization of these levels, and their transitions, that the ACAST[3] Ad Hoc Working Group on Computer Technology has prepared.[4]

Lastly, the point of what is Latin America again crops up. For the purpose of this work the categorized nations will be considered to be Latin America. That is, the twenty classical Latin American republics, plus Puerto Rico. Puerto Rico has been added for a particular reason. As part of the U.S. economy, there are absolutely no controls on the importation of data processing equipment into Puerto Rico. The effects of computer usage, economic, social and political, characterized by a U.S. technological modality in a Latin American cultural setting can best be studied in Puerto Rico for possible applications and analyses fitting the other countries in Latin America.

TABLE 2

Correspondence of CIDP Groups and
Expanded UN Level Concept

GROUP E----------INITIAL

GROUP D----------INITIAL-TO-BASIC

GROUP C----------BASIC

GROUP B----------BASIC-TO-OPERATIONAL

GROUP A----------OPERATIONAL

Installations:[6]

There are close to 3,000 computer installations in Latin America as a whole. Of these, almost 73% are what could be considered small computer systems, 23% medium sized, and 4% large.[5] More than 60% of all the computers in Latin America are concentrated in three countries: Argentina, Brazil and Mexico. Puerto Rico and Venezuela account for approximately 20%, and the remaining 20% is distributed among the other sixteen countries. Overall, about 40% of the total money amount of installed equipment is in the public sector, and 60% in the private. Public sector here is taken to mean government at all levels, autonomous and semi-autonomous agencies or administrations, state universities or other government-owned educational institutions, etc. Almost all of the Latin American nations concentrate their computers in the national capital, with about 80% of all computation being done, country by country, taking place in the capitals. A notable exception is Brazil, where Sao Paulo accounts for 45% of all such activity, and Rio de Janeiro for a little over 30%. The capital city, Brasilia, takes but a share of the remaining computers in the country.

Almost all United States manufacturers are represented in the Latin American market, with IBM greatly dominating the overall scene with approximately 75% of all systems. IBM's dominance is greatest in the smaller countries---exception made of Paraguay, where NCR shares half of the nation's six computers---and smaller in the larger ones, where many vendors have also entered the market. U.S. domination is almost complete, however, with the natural exception of Cuba, which is manufacturing its

own small computer systems and has also imported some of CII (Compagnie Internationale pour l'Informatique) Iris series computers from France. Aside from this, and a handful of German Siemens equipment in Brazil, all else is United States manufactured. In addition to IBM, the main vendors encountered are Burroughs, Univac, NCR, Honeywell-Bull, CDC, Hewlett-Packard, DEC, etc. TABLE 3 indicates which manufacturer's computers are presently found in the different countries.

Applications:

Most of the computer activity taking place in Latin America today is conventional information processing for administrative purposes. In this, there is no great divergence from the North American pattern. In the private sector it is almost all commercial applications related to the administrative operations and accounting of the enterprise. In the public sector the same holds relatively true. Sophisticated applications are only found at very selected avant garde installations in certain government agencies, banking operations, or large regional centers of multi-national corporations. Scientific computing is very scarce, but found mainly in a few universities or research institutions in the larger countries. A typical computer operation in any one country, at any one daily period, might be: (partially) payroll, invoicing, accounting, inventory, general statistics.

Education:

The computer manufacturers in general, and because of its sheer size, IBM in particular, account for the overwhelming share of education at the op-

TABLE 3

Manufacturers with Computers
Installed in Each Country

	BURROUGHS	CDC	CII	DEC	ELLIOTT	HEPWORTH & GRANDAGE ELEKTRONIK LTD *	HONEYWELL **	IBM	NCR	RCA	SIEMENS	UNIVAC	CID	OTHERS
ARGENTINA	x			x			x	x	x			x		x
BOLIVIA								x	x					
BRASIL	x			x			x	x	x		x	x		x
CHILE	x			x				x	x					x
COLOMBIA	x							x	x			x		x
COSTA RICA	x							x						x
CUBA			x		x								x	
DOMINICAN REP								x				x		
ECUADOR								x				x		
EL SALVADOR								x						
GUATEMALA						x		x	x					
HAITI														
HONDURAS								x						
MEXICO	x	x		x		x	x	x	x	x		x		x
NICARAGUA	x							x						
PANAMA								x	x					
PARAGUAY								x	x					
PERU	x							x	x					
PUERTO RICO	x	x		x		x	x	x	x	x		x		x
URUGUAY				x			x	x						
VENEZUELA	x			x		x		x	x			x		x

erations, programming and systems design and analysis levels. Through their education centers classes are imparted to the users' personnel in the different skills and techniques necessary to handle the equipment's operation and programming. However, due to the volatility of good skilled people in the data processing job markets, the demand has paved the way for the existence of many private schools offering similar courses. The quality of education here is usually not up to par, and in addition, no great care is taken to insure the ability or aptitude of the paying student to become a skilled programmer, for example. As in most other countries, initial systems, applications or programming languages cause some difficulties until they are mastered. Experience is unsubstitutable in the programming and systems analysis fields. This also holds true for the teachers. In many cases there has been the need for more experience on the part of the teachers also.

University education in computer science, or computer related fields, is weak in general. There are notable exceptions, such as the Pontificia Universidade Catolica (PUC) and the Universidad de Sao Paulo in Brazil, the Universidad de Buenos Aires and the Universidad Tecnológica Nacional (UTN) in Argentina, the Instituto Tecnológico de Monterrey in Mexico, and to a lesser degree the Central Universities in Caracas and Santiago de Chile. The main thrust throughout most high level institutions is limited, however, to the teaching of Fortran programming and some numerical analysis to science and engineering majors. In some of the schools offering degrees in computer science, systems engineering or related fields the biggest

difficulty was an orientation towards scientific computing when the market needed primarily commercial systems people. The realization of this problem has already given way to the creation of short tecnical, or associate degrees, at the UTN in Buenos Aires, and the Universidad Central in Caracas. The implementation of other similar programs is presently under study in Mexico, Chile and Colombia. However, there seems to be a major gap separating most Latin American universities from the real problems of their countries. In many cases the causes are political, and there exists a deep mistrust between the government and the universities. In other cases, it is due to tradition. One fortunate exception seems to be Mexico's Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) which works in close contact with the industrial and commercial community of Monterrey, from which it apparently receives substantial support.

Personnel:

The scarcity of qualified people at the higher level of data processing activities is the biggest problem confronting Latin American computation. The process is compounded in most countries by a double "brain drain", one external and one internal. The external drain is the classical migration of the skilled and well educated in search of higher salaries and technical aspirations. The internal drain drives people from the lower paying areas, such as government and smaller national enterprises, where their skills are most needed, to the higher paying foreign enterprises and multi-national corporations that might also eventually advance them out of the country if they are good enough.

In all of Latin America operations and most programming is already in

the hands of nationals. Systems analysis is also in most countries of Groups C through A. There is a remarkable absence of qualified systems analysts in some Group C countries and all the Group D and Group E ones. The source for most of the personnel at the programmer-analyst level is still much below the college level, and this in turn reflects some of the difficulties being confronted in the analyst situation.

Because of the traditional educational systems in Latin America, which generate a very pointed educational pyramid with very few people achieving relatively high scholarity, the necessary technical infra-structure to support computation beyond a minimal scale has never been achieved.

The paternalistic attitudes of employers, typical of the family type corporation which is still characteristic in Latin America, is also an important factor in personnel selection problems. Data processing thrives upon deep involvement and commitment of an enterprise's top management. This is rarely seen except when very influential and direct interests force this type of participation. Sometimes it may be through a foreign-educated son who has been introduced to and familiar with computers. In any case, there is a strong need for high level managerial awareness of computation.

Wages:

There are wide variations as to compensation for the different types of data processing functions in the different countries of Latin America.

These variations are a reflection of the country's general economic situation and the demand for the skills in question. In most countries of Latin America the demand is still growing for qualified personnel at the diverse functions specified, but that demand is much greater in some of the countries. These variations in demand, and the salary ranges, should be interesting in determining possible future migrations of DP personnel from one country to another. TABLE 4 presents a chart of approximate equivalents of wages in the different countries.

Chronology:

Although punched card unit record equipment entered Latin America as far back as 1911, it wasn't until 1957 that a computer proper was installed. This was an IBM 650 which was placed at the IBM Datacenter in Caracas, Venezuela. If the first data processing machines, prior to the computer, had been imported by the railroad companies, and government statistical bureaux, the first computers were brought in by the manufacturers and the oil companies. Universities and governments followed suit closely afterwards. By 1958 the Universidad Nacional Autonoma de México had its IBM 650 also, and in 1959 the Universidad de Chile installed a Standard Electric-Lorenz ER-56. Computers started entering the different countries to do a number of jobs, mainly in very large enterprises and in government. Banks were also quick to feel the pressure of large volumes and the need for automatic data processing equipment in the guise of computers. 1959 also saw the installation of some Ramac 305's and IBM 1401 computers, shortly after that the first attempt at serious computer education began in Argentina, Chile and Mexico.

TABLE 4

COUNTRY	CURRENCY	EXCHANGE RATE* PER U.S.$	AVERAGE SALARIES IN U.S. DOLLARS** SYSTEMS ANALYST	PROGRAMMER	COMPUTER OPERATOR	KEYPUNCH OPERATOR
ARGENTINA	PESO	0.1000	320.00	280.00	210.00	100.00
BOLIVIA	BOLIVIANO	0.0830	300.00	250.00	180.00	120.00
BRAZIL	CRUZEIRO	0.1666	708.00	467.00	320.00	200.00
CHILE	ESCUDO	0.0240	340.00	265.00	192.00	144.00
COLOMBIA	PESO	0.0460	450.00	375.00	230.00	120.00
COSTA RICA	COLON	0.1166	400.00	270.00	155.00	100.00
CUBA	PESO	1.0000	NO INFO	NO INFO	NO INFO	NO INFO
DOMINICAN REP	PESO	1.0000	750.00	550.00	425.00	215.00
ECUADOR	SUCRE	0.0390	280.00	220.00	140.00	88.00
EL SALVADOR	COLON	0.4000	500.00	350.00	190.00	125.00
GUATEMALA	QUETZAL	1.0000	600.00	400.00	315.00	260.00
HAITI	GOURDE	0.2000	N/A	N/A	N/A	50.00
HONDURAS	LEMPIRA	0.5000	500.00	425.00	275.00	150.00
MEXICO	PESO	0.0800	800.00	560.00	320.00	200.00
NICARAGUA	CORDOBA	0.1428	650.00	400.00	350.00	180.00
PANAMA	BALBOA	1.0000	550.00	400.00	275.00	180.00
PARAGUAY	GUARANI	0.0080	240.00	180.00	160.00	120.00
PERU	SOL	0.0230	600.00	450.00	275.00	150.00
URUGUAY	PESO	0.0012	205.00	144.00	108.00	60.00
PUERTO RICO	DOLLAR	1.0000	800.00	650.00	450.00	250.00
VENEZUELA	BOLIVAR	0.2300	900.00	700.00	450.00	200.00

* APPROXIMATE OFFICIAL RATES OF EXCHANGE DURING THE MONTH OF JUNE, JULY OR AUGUST OF 1972 FOR SOUTH AMERICA, DECEMBER OF 1972 FOR THE CARIBBEAN, AND JANUARY OR FEBRUARY OF 1973 FOR PANAMA, CENTRAL AMERICA AND MEXICO. OFFICIAL RATES FOR CHILE AND CUBA ARE GREATLY ABOVE REAL VALUE IN OPEN MARKET AT THE TIME.

** AVERAGE MONTHLY SALARY.

The mid-sixties brought third generation equipment into most of the countries in question, and with it the big increase in cost-performance ratios that allowed for possible investments of that magnitude by developing countries. This was especially true upon the appearance of the first massively marketed small computer, the IBM 360 model 20 in 1966. By 1970 this had become by far the most popular computer system in Latin America. Later systems around that level and below, such as IBM's System/3, and later still Burroughs B1700 are on their way now to insuring further growth at the small user level. This growth, using Boehm's[7] data for 1967-69, seems to be around 100% over the past 5 years.

GOVERNMENT ATTITUDES AND POLICIES:

Latin American governments are becoming increasingly aware of computation in their own countries. To a great extent this awareness comes from four basic causes:

1. The large cost in foreign exchange of the computers to the countries in general, and the governments in particular.
2. The increasing dependence of some government areas upon their data processing systems.
3. The incipient use of the computer as a source of power through its information holding capabilities.
4. The computer is a status symbol.

The first of these causes has been the most important one in defining the initial attitudes and some policies on the part of some governments. Studies on centralization of computation within government have been advanced by almost all countries within the last years as a manner of reducing costs. At the same time boards and committees have been created in many nations to review justifications for any new equipment that is requested. Of course there have always been, in most countries, certain import duties and currency control boards. These mechanisms acted as instruments of control, but without a knowledgeable basis as to the use and socio-economical benefits to be derived or not from the computer. Some nations are trying to implement similar schemes, without much success so far.

The increasing dependence of some governments on their computers many times brings them into a state of passive conflict with the dominant

supplier of the computer equipment. The dependence on the computers means dependence on the manufacturer, in many cases, and this breeds a situation which governments often view with some concern. It is common to see boards and commissions arise sometimes with some vague direct objective, and an underlying indirect one of controling the manufacturer's participation in the government's market.

The computer as a source of power through its information holding capabilities is a forceful reason. Yet it is only recently that some attempts of this have been seen. In part, the sophistication needed for some of the more effective uses of this tool in such a manner had been missing elements in many cases. Also, the quality of the information being stored has always been of doubt. But even as a crude source of power, such as knowing the salaries and incomes of all other employees; or simply withholding someone's check at month's end and blame the machine for not having produced it, it has the ingredients of a terrific tool.

Of course attitudes of the different governments are attuned by many factors, but without a doubt the importance of the computer as a status symbol is one of them. The computer is a status symbol both internally, among government ministries and agencies vying for power; and externally, among countries rivaling each other for prestige internationally.

The ACAST group has concluded:[8]

> Each developing country needs a broad national policy, consistent with its national goals, on the application of computer technology.

There are nations in Latin America like Haiti, or the Dominican Republic, that have absolutely no policy on the application of computer technology. On the other hand there are Cuba and Chile, with what appear to be very definite national policies in computation. In between, we find every possible situation. In any case, the instrumentation of a national computer policy is no easy matter. Most of the Latin American countries are either in the process of analyzing the causes and needs for this, or in the setting up of the initial organizations that might dictate such policy. The sequence seen in TABLE 5 places the different countries at the stage they find themselves at present.

There is also an underlying conflict among the advocates of control versus the advocates of non-control of computation. The first group argues mainly on the need for optimization of such expensive equipment by controlling its acquisition, orienting its usage and maximizing its hours of utilization. The second group emphasizes the importance of extensive hands-on experience as an educational tool, and the fact that most important applications are usually conceived after installation. Yet, in countries with hard currency limitations, and great primary needs, there should probably be some measure of control as first step towards a policy.

TABLE 5

Description of National Computer Policies by Country

1 ARGENTINA: Import duties; government awareness and studies made; computation in government monitored and some controls by Secretaría General de la Presidencia.

2 BOLIVIA: Import duties; government computation controlled by CENACO (CEntro NAcional de COmputación) as of 1970, although still a bit weak.

3 BRAZIL: Import duties; SERPRO (Servico Federal de Processamento de Dados) does most computation services for federal government; CAPRE and IBI, a coordinating committee for DP activities and a national informatics bureau have been recently created; very slight controls at present; studies under way.

4 CHILE: Very heavy import duties; ECOM (Empresa Nacional de Computación) controls all computation for the government and determines who in private enterprise can import a computer or not; tight controls; policy dictated by ECOM.

5 COLOMBIA: High import duties; Comisión de Normas controls new acquisitions by government, and DEPRO, within the DANE (Dep. Admin. Nacional de Estadísticas) does service within government; standards also commencing to be set by Comisión de Normas; INCOMEX allocates currency for importation of any equipment.

6 CUBA: Dirección Gral. del Plan Cálculo, under the JUCEPLAN, controls computation in the country; Instituto Cubano de Estudios Digitales manufactures small computers CID-201A, CID-201B, CID-202; National Informatics System in plans for installation.

7 DOM. REP.: Some import duties; no controls; minimum government awareness.

8 ECUADOR: Import duties; Comisión Nacional de Mecanización existed with advisory functions, but presently inoperative; no other controls.

9 EL SALVADOR: Import duties; some awareness; no controls, or definite plans; studies for centralization under way.

10 GUATEMALA: Import duties; some awareness; centralization in definite plans; Centro Nacional de Computacion in process of creation.

11 COSTA RICA: Import duties; Oficina Técnica Mecanizada exists since a long time with some theoretical duties, but totally passive; experience with centralization not good; no other controls, studies.

TABLE 5 (Cont.)

12 HAITI: Import duties; no controls; no awareness; no studies.

13 HONDURAS: Import duties; government equipment to be approved by Office of the Budget; no other controls; centralization studies under way with AID advice.

14 MEXICO: Import duties; government computing monitored and controlled as of recently by committee under Oficina de la Presidencia; Centro Nacional de Informática in plans, to dictate policy; Secretaría de Industria y Comercio must approve importation of any equipment; only new equipment, new technologies allowed into the country; certain tax incentives.

15 NICARAGUA: Import duties; no controls; some awareness; some studies in process.

16 PANAMA: Import duties; no controls; awareness; study underway for optimization of government equipment and possible policy board.

17 PARAGUAY: Import duties; no controls; minimum awareness; Centro Nacional de Computación exists at University but has little relation to government.

18 PERU: Import duties; no controls; government quite aware; studies in process at present.

19 PUERTO RICO: No import duties; government quite aware; Master Plan for Computation in government worked out; Advisory unit in DP exists under the Office of the Budget; a State Scientific Systems Center gives aid to all who need from the Highway Authority; Governor's Palace held information room with computer.

20 URUGUAY: Import duties; CONADI (Comisión Nacional de Informática) exists in advisory capacity; no other controls; studies under way for creation of national computing center.

21 VENEZUELA: Small import duties; government awareness; some attempts at setting standards; no controls; studies under way.

THE PRINCIPAL MODELS:

There appear to be five basic models taking shape in Latin America through which governments deal with computation. Of these, three are well defined and the other two are still undergoing modifications. The well defined ones are the Cuban, Chilean and Colombian models, the other two are the Brazilian and Mexican models.

The Cuban model:[9]

Cuba set a very ambitious plan for itself in 1968 to develop a computer industry, both from the hardware and software ends. This Cuban decision to manufacture small computer systems was coupled with a parallel plan to implement a national information system for which some large scale conventional equipment was contracted from CII, the French manufacturer. Under the Junta Central de Planificación (JUCEPLAN)---Central Planning Board---a Directorate for Electronic Computation was established that same year to coordinate the many activities of the Plan Cálculo Nacional and the Centro de Investigaciones Digitales (CID). The final objective of the diverse organizations dealing with the issue of computation is the establishment of a national information system for the control of the national economy. All computational needs in the country are handled by the system or not at all. Policy is dictated at the Dirección de Cálculo Electrónico, which is under the Central Planning Board, and should therefore be consistent with other national goals and policies.

The Chilean model:[10]

This model is based on the national computer enterprise concept put forth

by Friedmann[11] and embodied in ECOM (Empresa Nacional de Computación). ECOM exists since 1968, and was originally conceived of as an enterprise to give advice, services and education in the systems area within Chile. Created by the Christian Democrat government of Frei, the Marxist regime of Allende gave it further attributes and responsibilities which are allowing it to make computation almost a state monopoly controlled by ECOM. ECOM does dictate policy for the country as a whole, though there is still some infighting with some of the Universities which feel they have a stake in computation also. ECOM is an autonomous enterprise directly controlled by the government through its Board of Directors, which includes representation from the Development Corporation (CORFO), the Power Company (ENDESA), the Telephone and Telegraph Co. (ENTEL), and the employees of ECOM

The Colombian model:

Based on the Comision de Normas (Standards Commission) which functions with the participation of the DP managers of the larger government installations such as the DANE (Statistics Department), the Treasury, etc., Colombia controls and monitors the acquisition of new equipment by the government. A feasibility study must be made for each case and approved by the Comisión before any computer can be imported. At the same time it can provide alternatives to the requesting agency or dependancy by providing computer time and services at any one of the available government installations. The Comisión is also on the way to setting standards for minimum compatibility in the government. Importation of computers in the private sector is controlled by the currency allocation permit which must come from INCOMEX. This approv-

al, however, does not presently concern the Comisión de Normas, though it provides an instrument for participation should it so decide.

The Brazilian model:[12]

While still evolving, the Brazilian model has already some definite features. SERPRO, for example, a gigantic service bureau with over twenty different installations all over the country designed to do processing for the federal government. This service bureau organization concept, extended again and again at different levels in Brazil---PRODESP for the State of Sao Paulo, PRODAM for the City of Sao Paulo---allows for a much more flexible structure. This makes sense in a highly dynamic, and economically booming country like Brazil. In addition to SERPRO, this last year foresaw the creation of CAPRE (Comissao de Coordenacao de Atividades de Processamento Eletronico) to coordinate all DP activities in the government; and IBI (Instituto Brasileiro de Informatica) for more profound studies in the field of informatics.

The Mexican model:[13]

This incipient model is characterized by the formation of a committee under the personal aegis of the Presidencia to study the problems of computation in the country, propose a plan and implement it, to optimize computer utilization and dictate policy. Upon studying the problems and deriving solutions the Mexican model might possibly turn to the Brazilian or Colombian models for further implementation. An Argentinian attempt two years back seems to have met with similar problems and seems to have dispatched itself.

All these models do seem to have one point in common. That is, control. They all are interested in restricting, through monitoring and controlling, the widespread use of computers. This, in order to optimize results of the existing DP machines in government, and those to come . Some models are not very applicable. The Cuban model, for example, presupposes certain expertise, or the decision to achieve it, in manufacturing computer systems. The Brazilian model and the Mexican one are not yet stable enough as to present a clear cut panorama of alternatives.

Some intermediate models that have started to appear are the Bolivian one, influenced by both the Brazilian and Chilean models; and the Uruguayan, which seems to be strongly based on the earlier Chilean version, as exemplified by the creation of CONADI (Comisión Nacional de Informática) to advise the government on data processing.

CONCLUSION:

Computation in Latin America is a phenomenon that merits studying. It has had some very definite effects on certain political aspects of the host societies, and is sure to affect more deeply in the future. Governments are fastly becoming aware of the major investment they have made, and the payments they are still making, in order to use their computer equipment. The realization that they should optimize the results from the very expensive equipment leads to notions of centralization and control. The dependence on a manufacturer reinforces the country's desire for controlling a potentially dangerous situation. The increasing awareness of the power of the computer through its information holding capabilities enhances certain personal ambitions and aspirations for control which also reinforce the process towards the establishment of some instrument for elaboration of a national computer policy.

There have been various models emerging in Latin America by which different countries have attempted to handle the situation. Of these, five were cited and gone into with certain detail: the Cuban, the Chilean, the Colombian, the Brazilian, and the Mexican. All have some common characteristics in the fact that they tend to control computation. The Cuban model presupposes the most centralized decision system, followed closely by the Chilean, and less so by the Colombian. The Brazilian is characteristic of a much more economically free society, less socialistic and therefore less planned. The Mexican model is still too incipient to be evaluated, though it shows a numb-

er of promising characteristics.

Typically, though, the majority of the Latin American countries have not yet defined the route which they are going to follow, if anyone at all. Cuba is still relatively isolated for political reasons, but that situation seems rapidly changing, and if the Cuban model provides for some degree of success in dealing with computation, then it will undoubtedly be looked at in earnest by other Latin American countries. Chile has undoubtedly influenced Bolivia, Uruguay, Ecuador and to some degree Colombia. Brazil has reflected its model on Bolivia, Uruguay and Paraguay. Colombia seems to have had some influence on Panama and Venezuela. Mexico, unsettled as it still is, is influencing the whole of Central America.

The future years foreshadow important definitions in each one of the models described. As they evolve together with new necessities and eventualities, the countries in need of adopting solutions to their problems in the computer field may have a more defined panorama from which to choose his answers.

TABLE 6

COUNTRY	POPULATION (IN MILLIONS)	G.N.P. (IN $B)	TOTAL COMPUTERS	SMALL* SYSTEMS	MEDIUM* SYSTEMS	LARGE* SYSTEMS	COMPUTERS PER MILLION PEOPLE	COMPUTERS PER $8 OF G.N.P.	CIDP** RANKING
ARGENTINA	24.352	18.622	445	316	123	6	18.83	23.90	1
BOLIVIA	4.931	.716	12	12	0	0	2.43	16.76	19
BRAZIL	92.238	20.967	754	487	202	65	8.17	35.96	2
CHILE	8.836	4.147	52	36	15	1	5.88	12.54	6
COLOMBIA	21.116	5.141	86	50	35	1	4.07	16.73	7
COSTA RICA	1.766	.710	29	25	4	0	16.42	40.85	10
CUBA	8.250	2.274	40	36	4	0	4.85	17.59	12
DOMINICAN REP	4.012	.977	23	22	1	0	5.73	23.54	14
ECUADOR	6.093	1.188	20	20	0	0	3.28	16.84	15
EL SALVADOR	3.515	.840	21	20	1	0	5.97	25.00	17
GUATEMALA	5.170	1.471	27	25	2	0	5.22	18.35	18
HAITI	4.867	.303	0	0	0	0	0.00	0.00	21
HONDURAS	2.582	.556	16	14	2	0	6.20	28.77	20
MEXICO	48.313	23.304	573	398	149	26	11.86	24.59	3
NICARAGUA	1.982	.648	13	12	1	0	6.56	20.06	13
PANAMA	1.415	.794	28	20	8	0	19.79	35.26	9
PARAGUAY	2.374	.470	6	6	0	0	2.53	12.77	16
PERU	13.586	3.916	87	69	17	1	6.40	22.22	11
PUERTO RICO	2.677	3.245	300	250	40	10	112.07	92.45	4
URUGUAY	2.886	1.362	35	31	4	0	12.13	25.70	8
VENEZUELA	10.399	8.445	300	247	44	9	28.84	35.52	5
***UNITED STATES	205.000	829.200	70,000	-	-	-	344.90	84.74	-

* Definition taken from United Nations Publication. See Reference note 5.

** See Refernce note 1

*** United States information only included for comparison. Source: The Office, June 30, 1970.

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1) Barquin, R.C., "Development of the Computer Industry in the Latin American Nations: Strategies and Policy," Electrical Engineer's Thesis, M.I.T., June 1972, Appendix A.

2) Ibid, p28.

3) Advisory Committee on the Application of Science and Technology to Development (ACAST).

4) ---"The Application of Computer Technology for Development," United Nations Publication, New York, 1971.

5) the same criteria as the UN group, the division is:

Small---up to and including 32K of core memory
Medium--over 32K and up to 256K of core memory
Large---over 256K of core memory

6) This information was collected during an M.I.T. sponsored research trip throughout Latin America from June through August 1972, and December 1972 through February 1973.

7) Boehm, B.W., "Computing in South America," Datamation, May 1970, p98.

8) United Nations, p7.

9) Carnota Lauzan, O., "La Aplicación de las Computadoras en el Campo Económico en un Pais en Vias de Desarrollo," Proceedings of the Conference on the Role of Computers in Economic and Social Research in Latin America, Cuernavaca, Mexico, October 25-29, 1971. (To be published by the National Bureau of Economic Research.)

10) Personal communications to the author by Ing. Miguel Leonvendagar, Director of Planning for ECOM, in Santiago de Chile, July 1972.

11) Friedmann, E., "Management of Computer Resources in Less Developed Countries," Jerusalem Conference on Information Technology, Jerusalem, Israel, V1, p295, August 1971.

12) ---"Computing in Brazil 1972," Newsletter of the Sao Paulo Chapter of the ACM, July 1972.

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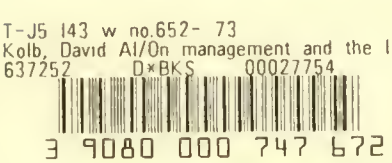

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